Estimating the "memory of landscape" to model changes in archaeological settlement patterns

Laure Nuninger, Philip Verhagen, Frédérique Bertoncello

Estimating the 'memory of landscape' to model changes in settlement patterns

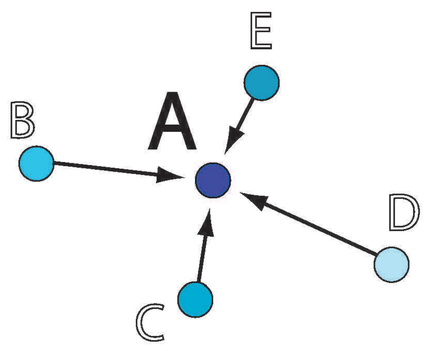
Laure Nuninger[1], Philip Verhagen[2] and Frédérique Bertoncello[3]
[1] Chrono-environnement UMR 6249, CNRS Besançon
[2] Faculty of Humanities, VU University Amsterdam
[3] CEPAM UMR 7264, CNRS Nice

BACKGROUND

Location preferences of (Roman) rural settlements are not just linked to environmental factors. In this study, we want to look at the influence of previous occupation of the landscape on settlement location. What would be the best suited location in a landscape?

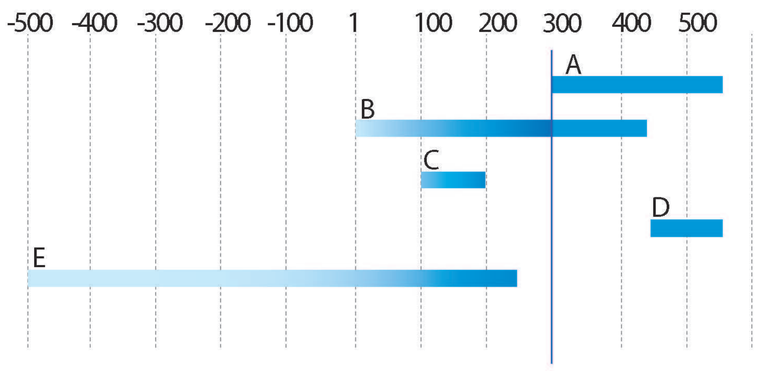
1) an environment that was not settled before, offering the best soils and an advantageous topographic position?
2) a site that was occupied before, offering e.g. building materials that were left behind?
3) or an environment that had already been adapted, e.g. by clearances, parcellation or soil improvements?

In order to study this effect, we developed a method to calculate a 'heritage map' based on the concept of 'memory of landscape'. Such a map can be seen as one variable among many others influencing site location preference, and can be used as input for predictive models. The computed values equate to an index of long-term land use intensity.



THE CONCEPT OF HERITAGE

In the surroundings of settlement A, a number of settlements (B-E) are found, dating from various periods. The 'heritage' of settlement A is a function of the geographical distance to these settlements, as well as the duration of previous settlement.



TEMPORAL WEIGHTING

Each one of the settlements B-E will be weighted according to its duration of occupation, relative to the start of settlement A's occupation. The weight of duration will decrease by 0.2 for each century. This will then lead to the following weights in our example:

B = 100 x 1 + 100 x 0.8 + 100 x 0.6
= 240

C = 100 x 0.8
= 80

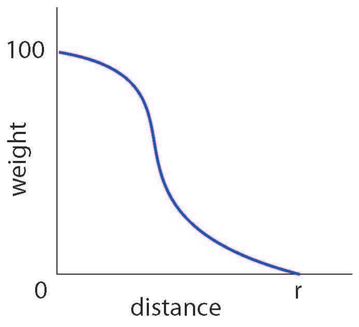
D = 0

E = 50 x 1 + 100 x 0.8 + 100 x 0.6 + 100 x 0.4 + 100 x 0.2 + 100 x 0
= 250

The total weight of the 'heritage' of the settlements surrounding settlement A is then 240 + 80 + 250 = 570.

SPATIAL WEIGHTING

The heritage weight is then modified according to the distance of each settlement to settlement A. This is achieved by using a non-linear distance decay function within a pre-defined radius around settlement A.



0	0	0	0	0
0	0	0	250	0
240	0	A	0	0
0	0	80	0	0
0	0	0	0	0

Temporal Weight

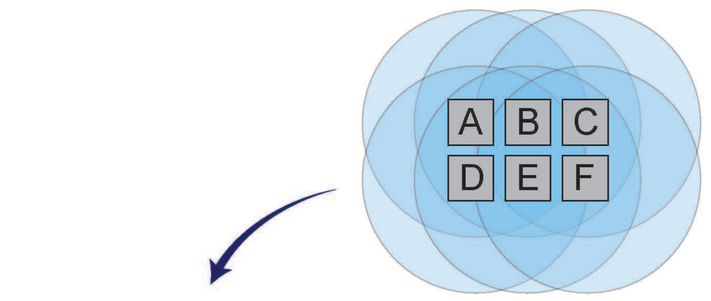
0	10	20	10	0
10	40	60	40	10
20	60	100	60	20
10	40	60	40	10
0	10	20	10	0

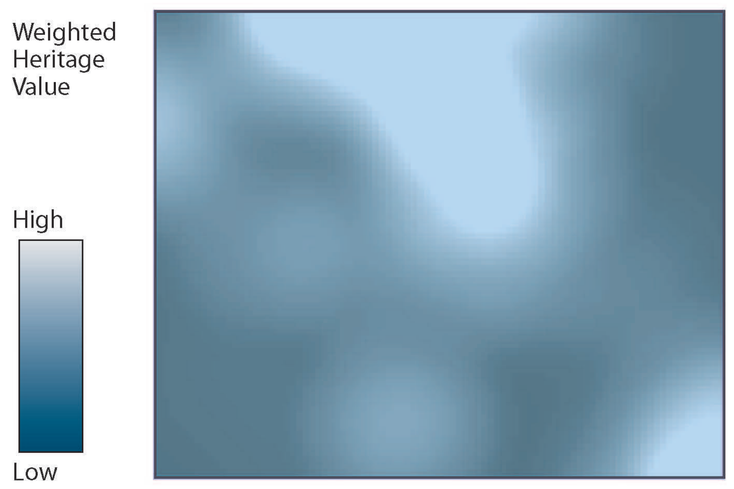
Spatial Weight

The final weighted 'heritage' of the location of settlement A in this example is 240 x 20 + 80 x 60 + 250 x 40 = 1960.

HERITAGE MAP

This concept can be applied not just to settlements, but to the whole landscape. For this we made a kernel density map based on the distance decay function with weights calculated for each and every location on the map.





DISCUSSION

The method presented here uses weights that were established by means of expert judgement rather than by a good understanding of the role of the memory of landscape in settlement pattern development. We will need to experiment more with different types of temporal and spatial weightings to see what works best in practice.

Furthermore, a successful application of the heritage map in settlement pattern analysis also depends on the availability of reliable settlement data, both in a spatial and temporal sense.

Nevertheless, the heritage map is a much-needed addition to the prevalent environmental approaches to questions of site location analysis, as it includes a true socio-cultural factor, the 'memory of landscape'. Together with other factors, such as accessibility and hierarchical position, it can help to broaden our understanding of settlement pattern changes.

PUBLICATIONS

P. Verhagen, L. Nuninger, F.-P. Tourneux, F. Bertoncello and K. Jeneson, 2013. 'Introducing the Human Factor in Predictive Modelling: a Work in Progress', in G. Earl, T. Sly, A. Chrysanthi, P. Murrieta-Flores, C. Papadopoulos, I. Romanowska and D. Wheatley (eds), *Archaeology in the Digital Era. Papers from the 40th Annual Conference of Computer Applications and Quantitative Methods in Archaeology (CAA), Southampton, 26-29 March 2012*, Amsterdam University Press, Amsterdam, pp. 379-388.

L. Nuninger, P. Verhagen, F. Bertoncello, F.-P. Tourneux, 2012 - Des contextes spatiaux de l'habitat aux processus de transformation de l'habitat rural : l'apport de la modélisation prédictive. In F. Bertoncello, F. Braemer (eds), *Variabilités Environnementales,Mutations sociales: Nature, Intensités, Échelles et Temporalités des changements . XXXIIe Rencontres Internationales d'Archéologie et d'Histoire d'Antibes, 20-22 octobre 2011*, APDCA Éd., Antibes, pp. 231-246.

F. Favory, L. Nuninger, L. Sanders, 2012 - Integration of Geographical and Archaeological Concepts for the Study of Settlement Systems. *L'Espace Géographique* 2012-4: 295-309.

ACKNOWLEDGEMENTS

This research was partly made possible by grants from
- NWO, The Netherlands Organization for Scientific Research
- Réseau Franco-Néerlandais
- Ministère des Affaires Étrangères et du Développement International
- University of Franche-Comté & CNRS

FURTHER INFORMATION

contact us by e-mail
Laure Nuninger: *laure.nuninger@univ-fcomte.fr*
Philip Verhagen: *j.w.h.p.verhagen@vu.nl*
Frédérique Bertoncello: *frederique.bertoncello@cepam.cnrs.fr*